

**WHAT IS CLAIMED IS:**

1. A method of fabricating a micro-lens, comprising the steps of:
  - (a) forming a thin film of a material for the micro-lens on a substrate;
  - 5 (b) forming a photoresist pattern on the thin film;
  - (c) forming a thin-film structure by etching the thin film using the photoresist pattern; and
  - (d) forming the micro-lens by reflow by thermally treating the thin-film structure.
- 10 2. The method of claim 1, wherein the thin film material in step (a) comprises SiO<sub>2</sub> containing a dopant.
3. The method of claim 2, wherein the dopant comprises one of GeO<sub>2</sub>, P<sub>2</sub>O<sub>5</sub>, B<sub>2</sub>O<sub>3</sub>, TiO<sub>2</sub>, and Al<sub>2</sub>O<sub>3</sub>.
- 15 4. The method of claim 2, wherein the dopant includes one or more materials selected from the group consisting of GeO<sub>2</sub>, P<sub>2</sub>O<sub>5</sub>, B<sub>2</sub>O<sub>3</sub>, TiO<sub>2</sub>, and Al<sub>2</sub>O<sub>3</sub>.
5. The method of claim 1, wherein a plurality of micro-lenses are fabricated  
20 on the substrate, and the shape of each micro-lens is controlled according to a distance between respective thin-film structures arranged on the substrate to form the plurality of micro-lenses.

6. The method of claim 1, wherein the shape of the micro-lens is controlled according to the thickness of the thin film formed in step (a) and the shape of the photoresist pattern formed in step (b).
- 5        7. The method of claim 1, further comprising: (e) forming a non-reflective coating layer on the surface of the micro-lens.
8. A micro-lens manufactured according to the process recited in claim 1.
- 10       9. A micro-lens manufactured according to the process recited in claim 3.
10. An array of micro-lenses manufactured according to the process recited in claim 5.
- 15       11. A method of fabricating an optical module having a micro-lens integrated therein, comprising the steps of:
- (a) sequentially forming a lower cladding layer and a core layer on a substrate;
- (b) forming a planar lightwave circuit (PLC) pattern on the substrate by selectively etching the core layer and the lower cladding layer;
- 20       (c) forming a PLC by forming an upper cladding layer on the overall surface of the substrate;
- (d) forming a thin-film structure in a lens forming area by selectively removing the upper cladding layer in an area other than the area of the PLC and the lens forming area; and

(e) forming the micro-lens by reflow by thermally treating the thin-film structure.

12. The method of claim 11, wherein the thin film is formed of  $\text{SiO}_2$  containing a dopant.

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13. The method of claim 12, wherein the dopant comprises one of  $\text{GeO}_2$ ,  $\text{P}_2\text{O}_5$ ,  $\text{B}_2\text{O}_3$ ,  $\text{TiO}_2$ , and  $\text{Al}_2\text{O}_3$ .

14. The method of claim 12, wherein the dopant includes one or more materials  
10 selected from the group consisting of  $\text{GeO}_2$ ,  $\text{P}_2\text{O}_5$ ,  $\text{B}_2\text{O}_3$ ,  $\text{TiO}_2$ , and  $\text{Al}_2\text{O}_3$ .

15. The method of claim 11, wherein the shape of the micro-lens is controlled according to the shape of the photoresist pattern and the thickness of the upper cladding layer.

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16. The method of claim 11, further comprising: (f) forming a non-reflective coating layer on the surface of the micro-lens.

17. An optical module manufactured according to the process recited in  
20 claim 11.

18. An optical module manufactured according to the process recited in claim 13.

19. A micro-lens comprising:
  - a thin film of a material arranged on a substrate;
  - a photoresist pattern formed on the thin film, wherein a thin-film structure is
  - 5 formed by etching the thin film using the photoresist pattern; and
  - a lens comprising the thin-film structure reflowed on the substrate.
  
20. An optical module having a micro-lens integrated therein, comprising:
  - a lower cladding layer and a core layer arranged on a substrate;
  - 10 a planar lightwave circuit (PLC) pattern arranged on the substrate by selectively etching portions of the core layer and the lower cladding layer from the substrate;
  - an upper cladding layer arranged on the overall surface of the substrate; and
  - a thin-film structure arranged in a lens forming area of the substrate by removing
  - the upper cladding layer in an area other than the area of the PLC and the lens forming
  - 15 area; and
  - a lens comprising a controlled reflow of the thin-film structure.